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GRADE NINE MARKS AS PREDICTOR CRITERIA FOR SUCCESS IN SELECTED VOCATIONAL SUBJECTS

by

THEODORE ROY CAMPBELL

A THESIS

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The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Grade Nine Marks as Predictor Criteria for Success in Selected Vocational Subjects," submitted by Theodore Roy Campbell, in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

This study used data from the grade nine and grade ten levels in an Edmonton Composite High School, for three consecutive school terms.

The data used at the grade ten level were the final marks of vocational students taking one or more of nine selected first year vocational subjects. The subjects used included Automotives 12, Beauty Culture 12, Carpentry 12, Commercial Foods 12, Drafting 12, Electricity 12, Graphic Arts 12, Pipe Trades 12 and Sheet Metal 12. The data used at the grade nine level were the final grade nine marks for the same vocational students. The grade nine subjects used included Reading, Literature, Language, Social Studies, Mathematics, Science, Verbal S.C.A.T. and Quantitative S.C.A.T.

The grade ten data were compiled from school administration reports for each of the school terms 1964, 1965 and 1966. The grade nine data were compiled from reports from the Department of Education for each of the school terms 1963, 1964 and 1965.

The data from each of the three terms were treated collectively as one sample so that N's of sufficient magnitudes were obtained in all but two subjects. The two subjects considered to be too low to produce reliable data were Beauty Culture 12 and Commercial Foods 12.

The means of each set of grade nine data for each of the three school terms were examined. It was assumed that although some differences between the average means for each of the terms was evident, these differences were not of sufficient magnitude to prevent the three terms from being treated collectively as one sample.

The purpose of the study was to analyse the relationship between grade nine achievement and success in each of the selected grade ten vocational subjects.

The results of the statistical analysis indicated that certain subjects and groups of subjects in grade nine had some predictive value for success in certain grade ten vocational subjects. Grade nine Science and Mathematics accounted for three each of the highest correlations with the grade ten vocational subjects. The grade nine Quantitative S.C.A.T. accounted for two of the highest correlations with the grade ten vocational subjects; while Social Studies accounted for one of the highest correlations.

It was concluded therefore, that the grade nine Science, Mathematics, Quantitative S.C.A.T. and Social Studies final scores had some value as predictor variables for success in certain grade ten vocational courses.

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PROBLEM PERSPECTIVE

Introduction

World technological advancements in the past two decades produced an internationally competitive situation among national education systems.

Russia's launching of Sputnik I in October, 1957 and Sputnik II in November, 1957, set off repercussions in the western world which had a tremendous impact on educational systems.

Both Canada and the United States became acutely aware of their position in world technology leadership. In the years following Sputnik I and II, billions of dollars were channelled into the development of new programs of technical and vocational education, while at the same time, existing programs were strengthened in an effort to awaken the public to the increased importance of education in an age of advancing technologies.

The Canadian government has been involved administratively and financially in vocational education since the 1920's. From that time to 1958, "over $41,000,000. were spent in vocational education."[1] The total amount increased

yearly. In 1960, over $75,000,000. was appropriated through the Technical and Vocational Training Act (SC 1960-61, C.b.). This provided incentives for school boards across Canada to take advantage of the 75% subsidy on the costs of building and equipping vocational schools.[2]

The provinces implemented working agreements with their individual school boards and in many cases added a further subsidy of 15%. Substantial bursaries of $4,000 and $3,000 were also offered to suitable applicants from industry so that these people were able to attend university to receive the required methodology to qualify them as vocational teachers.

The unprecedented movement by school boards into the field of vocational education was accompanied by many problems, compounding the scene of an already complex educational picture.

The problems included:

1. The selection of courses suited to the particular employment environment of a community.
2. The implementation of liaison procedures with technical institutes so that course sequences could be properly articulated.

3. The setting of standards of admission to university for potential vocational instructors.

4. The attraction of sufficient number of qualified people from industry who were interested in becoming vocational teachers.

5. The distribution of federal money to the individual school boards.

6. The negotiation of salaries for vocational teachers and the resulting implications with professional associations.

7. The administration of vocational schools and the integration of these schools with existing composite high schools.

8. The education of the public and the potential vocational student population about the values of vocational education.

9. The planning and equipping of educational facilities about which little or no previous experience or knowledge had been acquired.

10. The selection and guidance of vocational students.

Adding to the growing number of problems, deadlines were set by the Dominion government for the use of vocational grants. "The federal government will contribute 75% of the total amount expended by a province on the building and

equipping of vocational training facilities up to March 31, 1963."[3] As a result many school boards were faced with improperly planned buildings, deficiencies in staff, inadequate and wrong equipment and poorly planned or unrealistic course outlines.

These elements contributed to a state of flux not previously known in Canadian Education.

Results however were still gratifying. Thousands of students formerly slated as high school drop-outs became instead, vocational students. Rancier, in his study of high school drop-outs found that "one of the major reasons for students dropping out was a desire to take courses of a more vocational nature than those offered in the academic program."[4] They were eliminated in large measure from the ranks of the multitudes who had previously spent an average of six years of waiting, once having left school, before entering a training institute of some kind. Findings from the literature in connection with students attending provincial Technical Institutes indicated that an average of six years elapsed from the time the student left high school or public school to the time he entered the Institute.

While the student may have contributed to society in many ways during this interim period, educators will probably concede that most of the six years would not have been profitably spent. There was obviously a tremendous waste of productive time and talent which could never be recovered and at a time when the talents of all Canadian youth were sorely needed.

Although the cost of vocational education is high, many millions of dollars will be returned to the Canadian economy as a result of the more efficient use and effective development of the talents of Canadian young people.

The ranks of the unemployed will undoubtedly be reduced. Thousands of young people will acquire a vocational education and will be available to help fill the great gap in Canadian technological fields. In addition, many potential law offenders have found their niche in a vocational high school program simply because there has been made available to them a wide variety of vocational choices at a time when it is most crucial that their energies and development be directed in acceptable channels.

This is one of the phases of school administration where the guidance department of a vocational school assumes

a position of extreme importance. Students need all the predictive knowledge they can obtain with respect to making an intelligent choice of subjects when moving from grade nine to grade ten. They often query a counsellor mercilessly about the different aspects of the vocational courses offered, as well as what is required to be a success in these courses. Competent and experienced counsellors are not always available. However, irrespective of the multitude of choices offered and the availability of counselling services, the requests and desires of some students simply cannot be met. Consequently, additional statistical data of a predictive nature would be of great value to both student and counsellor when assessing the student's potentialities.

The problem becomes essentially an admission problem. This is one of the areas that is of vital concern to this investigation.

The Problem

This study was concerned mainly with the admission of students to a vocational high school program. One of the problems associated with admission is that of establishing the relationship between the past and expected performance of the individual.

The predictive value of his grade nine achievement score may be an important measure of his chance of success in certain grade ten vocational subjects. It was therefore the purpose of this study to evaluate the degree to which five grade nine achievement and two ability variables act as predictors of success in eight grade ten vocational subjects.

The grade nine variables used were:

> The final scores in stanine form as reported by the Department of Education for Reading, Literature, Language, Social Studies, Mathematics, Science, Verbal SCAT and Quantitative SCAT for the school terms ending June 1963, June 1964, and June 1965.

The grade ten variables used were:

> The final scores for each student as reported by the school administration to the Department of Education for Automotives 12, Beauty Culture 12, Carpentry 12, Commercial Foods 12, Drafting 12, Electricity 12, Graphic Arts 12, Pipe Trades 12, and Sheet Metal 12 for the school terms ending June 1964, June 1965, and June 1966.

All scores used were for students attending a vocational high school in Edmonton, Alberta for the three consecutive terms as stated. Only those students for whom complete data were available have been included in the study.

Null Hypothesis

There is no significant relationship between Category A and each of the subjects in Category B as outlined.

Category A

The final scores in stanine form of grade nine students as reported by the Department of Education for English (Language), Mathematics, Reading, Science and Social Studies, Verbal SCAT, and Quantitative SCAT for the school terms ending in June 1963, June 1964 and June 1965.

Category B

The final scores of grade ten vocational students as reported by the school administration for Automotives 12, Beauty Culture 12, Carpentry 12, Commercial Foods 12, Drafting 12, Electricity 12, Graphic Arts 12, Pipe Trades 12, Sheet Metal 12, for the school terms ending June 1964, June 1965, and June 1966.

Definitions

Final Score shall be defined as that measure of success obtained on each of the grade nine tests administered by the Department of Education for the school terms ending in June 1963, June 1964, and June 1965.

SCAT shall be defined as the School and College Ability Test as used by the Department of Education for the testing of grade nine students.

Stanine shall be defined as the final mark in a course assigned to an individual in grade nine as reported by the Department of Education on the list of grade nine marks sent to the administration of the school from which the data was obtained.

Vocational course shall be defined as a course designated by the School District and the Department of Education as a vocational course and signified by the number twelve placed after the name of the course, such as "Graphic Arts 12".

Vocational student shall be defined as a student who has registered in and obtained a final score in a grade ten vocational course.

High school shall be defined as a school which included grades ten, eleven, and twelve, the last grades in a sequence of twelve grades.

Limitations of the Study

This study was concerned with the seven grade nine variables, as listed, and the relationship that exists between these variables and each of the selected grade ten vocational subjects.

In addition, the writer was concerned specifically with the value that the grade nine variables might have had for predicting success in each of the selected grade ten vocational courses offered in the school concerned.

References

[1]Canada Year Book, (Research and Education, Ottawa: Queen's Printer, 1962), p. 303.

[2]Ibid., p. 296.

[3]Ibid.

[4]G. R. Rancier, "Case-Studies of High School Drop-Outs," Alberta Journal of Educational Research, 9:12-13, 1963.

CHAPTER II

CANADIAN VOCATIONAL EDUCATION

A number of situations of importance have been observed in vocational school systems. Where these programs exist in Canada, they are generally new, drafted in the last five to seven years and usually based on the immediate needs of the community which draws in large measure on the school system for its employees. It is important as Walker (1955) confirms, in his U.S. study of sixty post high school students and their counsellors, "that the capabilities of each individual be exploited to the fullest in order to more nearly achieve maximum productivity and efficiency."[1] Broader, national requirements are therefore considered by most systems. Courses such as Drafting, Automotives and Electronics, often thought of as core courses, are in demand generally throughout Canada and are nearly always included in school programs.

Professional educators are acutely aware of the problems of setting programs, of implementing one kind and eliminating another, depending on the availability of certain types of employment in the community. Compounding this problem is that of correctly guiding a student into a

particular cluster of vocational subjects. Students require a great deal of predictive knowledge in order to make an intelligent decision regarding their selection of a vocational pattern in grade ten. Several sources supply this knowledge. Included is the student's self perception of his goals, his past performance, and the experience and advice of the counsellor and teacher. Walker indicates that "studies reveal that the counsellor's judgement influences the decisions young people make."[2]

In addition to the judgement of the counsellor, students are influenced seriously by other elements. Evans (1945), for instance, in an Edmonton Public Schools investigation involving twelve hundred students, found that "eight hundred and sixteen of them dropped out without completing the high school program."[3] Although a high proportion of the drop-outs were grade IX "C" students, the investigator concluded that "this may demonstrate the need for courses adapted to the needs of these people, instead of offering them an academic program with which they apparently cannot cope."[4]

Presently there are many criteria used for admitting a student to a particular vocational program. One of these

is the enrollment quota (first to be registered, first to be admitted). Further enrollment is eliminated after the quota is reached. Pre-requisite standings in certain grade nine courses constitute another reason. For instance, most Edmonton schools will not admit a student to an Electricity 12 class without at least a "B" standing in grade nine Mathematics and Science.

The admission of any student, including those lacking admission qualifications, to a course which is not filled to capacity is also frequently practiced, especially during the first few years of a school's operation. Individuals are also admitted to vocational patterns based entirely on their own preference for a certain course, with no other factors apparently influencing their choice.

Many more processes based mainly on opinion and experience, are utilized in admitting students to vocational patterns. The need for a statistically based approach on which these processes could be based is apparent. Any element contributing to this would be of value. For instance, evaluative criteria for vocational courses which would indicate the relative difficulty of these courses would be extremely useful information. Clusters of vocational subjects related to each other on one or more points and

correlated to subjects taken previously could possibly serve as guide patterns for students and counsellors.

Schools also face the problem of over-enrollment in certain classes. The decision to restrict enrollment after a class is filled to systematically eliminate certain individuals so that others can be admitted, is a major problem. Students are eliminated on several points. Included are:

1. The lack of adequate standings in required subjects.
2. Poor marks in presumably related but not required subjects.
3. General unsuitability based on aptitude profiles.

After elimination, other more suitable applicants are admitted. The alternative to this procedure is to open another class and admit all those who wish to take the course and can qualify for admission. The area of admission concerned with prerequisite standings is one which is open to serious criticism in certain instances. For example, in many cases, a student will do well in a class for which he did not qualify for admission but was admitted due to extenuating circumstances. These cases seem to nullify the basic reasons for pre-requisites, or at least some of those

which are used. However, many of the new vocational courses have never been assessed as far as difficulty level is concerned and experimental admission to these courses often yields information which offsets previously held opinions. There are many variables concerned with admission including the experience of the teacher, the maturity level of the student, and marking practices, to mention a few, so that a controlled situation is necessary before valid conclusions can be drawn respecting the results of individual cases. The implication is, however, that a matrix indicating the regressed relationship between grade nine marks and success in grade ten vocational courses would indeed be a useful instrument for administrators and counsellors when considering admission policies.

Of course school boards must exercise their responsibilities to the public in the spending of the tax dollar. Facilities and personnel cannot be provided continually on the basis of having sufficient of both to satisfy all the whims and desires of all students. In many cases however, school boards have attempted to provide facilities to accommodate all student requests. This cannot be economically justified on a continuing basis. The admission of

students to vocational and other classes must be accomplished through the use of sound counselling techniques and processes, based on valid and reliable statistical information. Only when this takes place will education systems be fulfilling what may be their most important goal: that of educating an individual suited to work for which there is a demand and for which he is trained and happy to follow.

References

[1]J. L. Walker, "Counsellors' Judgements in the Prediction of the Occupational and Educational Performance of Former High School Students," Journal of Educational Research, 49:81, 1955.

[2]Ibid.

[3]K. L. Evans, "The Academic History of the 1945 Grade Nine Class in their Subsequent High School Careers," (unpublished Master's thesis, The University of Alberta, Edmonton, 1953), p. 92.

[4]Ibid.

CHAPTER III

SURVEY OF THE LITERATURE

This study is essentially categorized as a statistical prediction study. Literally thousands of prediction studies have been carried out and of course, more are being completed. Many studies have been, according to the writer's survey, conducted in relation to the last year of high school and the first year of university or college. A number are of significance to this study and are presented here, indicating their logical relationships. Many other studies of a statistical predictive nature have been reviewed. These studies have been categorized and their relevance to this study has been set out where applicable.

Studies made in relation to predictive values obtained in pre-high school years and their value as high school success criteria have the greatest implications to this study. Although there is a substantial number of Canadian studies, the great bulk of the research in this area has been carried out in the United States. More concern however, has been given to Canadian studies since the development of vocational education in Canada likely had more relevance to the writer's investigation.

Studies Relating Grade Twelve and First Year University

The great bulk of prediction studies have shown that the high school average (grade twelve) is the best predictor of first year university success. Single predictors vary according to local norms but the high school Physics mark and Mathematics mark show consistently high relationships to success in the first year at university.

In a study of problems of admission, Knowles (1965) (University of Alberta) found that practically all studies surveyed indicated that the high school average was the best single predictor of university success.[1]

Travers (1949) stated in his study also that the high school average was the best single predictor of university success.[2] Garrett (1949) surveyed hundreds of United States studies and confirmed that "the high school average had the greatest correlation with university scholastic average. Correlation coefficients ranged from .29 to .82 with a median of .56."[3] He also found that the high school average predicted the first year university average better than it predicted any lesser or greater part of the university program.[4]

Henry (1950) (Toronto, Ontario) also confirmed that the high school average was the best single predictor of university success.[5]

Many other studies confirm, in varying degrees, the high correlation between university freshman success and the grade twelve average.

Black (1960)[6] and Zurowsky (1959)[7] (University of Alberta) applied the technique of multiple correlation to compare combinations of the standardized tests used in the 1956 grade twelve survey with combinations of first year university marks. Zero order correlation coefficients served to confirm the effectiveness of the departmental examinations as predictors.

Black (1960) (University of Alberta) also used a multiple correlation technique for the comparison of various combinations of predictor variables. Indications were that the combinations of seven grade twelve examinations scores which were required for entrance in the freshman engineering class, yielded as great a multiple correlation coefficient (R_7=.686) with the freshmen engineering class average as did the combination of grade nine marks and standardized tests (R_{25}=.687).[8]

The importance of findings such as Black's and Zurowsky's is an indication of the relatively high efficiency of multiple regression equations. Zurowsky (1959) found that the best predictors of first year university achievement were batteries or combinations of standardized tests at the grade nine and grade twelve levels. He used a multiple regression technique to produce these results. Black (1960) confirmed Zurowsky's findings by showing that combinations of grade twelve standardized tests were superior to individual tests as predictors of success in the first year of university. He compared groups of grade twelve tests with groups of first year university tests by using a multiple regression technique. The usefulness of this kind of technique when applied for guidance purposes within individual school complexes is recognized. However, there are certain limitations at the high school level. The use of high school personnel for instance, is not automatically feasible, since most counsellors would not be familiar with the statistical procedures nor with the manner of interpretations. Supporting this, Mack (1963) (University of Alberta) indicated that "investigations of multiple correlations have not proven to be useful because of their

complexity of interpretation and prediction for the average counsellor."[9] As school personnel become more versed in statistical techniques and the availability of computing equipment is less of a problem, the use of multiple regression equations will undoubtedly hold an undisputed place in the guidance and administrative departments of all schools in systems of substantial size.

Wesma and Bennett (1959) (New York) in an attempt to simplify prediction techniques found that the simple addition of verbal ability, numerical, and information scores on the college qualification tests were "just about as valid in predicting grade point averages as the regressed weight sums of the same scores."[10]

Black (1964) (University of Alberta) suggested that the regression equations developed in his study on predicting engineering freshmen success at university "could be modified for use in large schools with little effect on their predictive efficiency."[11] Black identified these reduced regression equations as "operational regression equations."[12] Black's study indicated that after six years the regression equations were still good predictors. He found also that ". . . Physics 30 is the highest and most frequent positive

contributor to success in engineering. Following closely were Social Studies 30 and Chemistry 30. There was a consistent inverse relationship between English 30 and all university freshmen courses, except English 250."[13]

Having analyzed Black's study (1964) (University of Alberta), the possibility of a parallel relationship between grade nine Science and Social Studies and grade ten vocational courses such as Electricity and Drafting must not be overlooked. Probably the most important finding of all prediction studies reviewed is that the combined predictive value of groups of scores is better than any single predictor. Confirming this, Black (1949) (University of Alberta) stated, after completing a study of predictive relationships between grade nine and grade twelve, that "it is evident from this and other studies that as a predictor the single factor method fails."[14] Black, favouring the multiple technique, states that "a predictive measure of utility to educators will no doubt be a complexity of factors, weighted according to their influence."[15]

It is precisely this kind of predictive battery that this writer hopes to establish in this study.

Further studies in relation to multiple and single factor predictors were reviewed.

Newland (1923) (University of Alberta) studied factors related to success or failure in school. Newland felt that "the potential ability in any individual was the most important factor related to high school success."[16] Potential ability of course must of necessity be defined. For decades the Intelligence Quotient of an individual was felt to be the most important indication of potential ability. However, this single measure has lost its status. Its validity and reliability, as a result of a multitude of studies, has proved to be inaccurate. Newland, for instance, concluded that "school marks and Intelligence Quotient, although significantly related, are not alone sufficient to predict success or failure."[17] Ross and Hooks (1930) (United States) confirmed also: "It must be granted that intelligence test scores have shown up disappointingly both as regards validity and reliability."[18] It was concluded that "there is a wide difference of opinion among educational authorities as to whether intelligence or aptitude tests, character or personality ratings by the

teachers, achievement tests, or previous school records afford the best basis of prediction."[19]

A number of other factors were found to be significantly correlated with high school success or failure. For instance, stability, instability scores, and home status ranks showed significant correlations with school marks. The investigation indicated also that those students who did "a significantly greater amount of reading tended to belong to the successful group of students."[20]

Another implication which further adds to the galaxy of factors affecting high school success or failure according to Newland was that "85% of students in the failure group tended to belong to clubs as opposed to 55% of the students with the passing groups."[21]

Other studies indicate that a great range of factors exist in the complex make-up of a student's potential ability.

Tozer's study (1930) (Winsor, Colorado) of a group of 132 high school students in grades nine to twelve, said that "a satisfactory prediction meets three conditions: validity, reliability and usability."[22] Tozer concluded that "results tend to show that if a counsellor had an

accurate rating for school habits on the high school entrant as well as his I.Q. he would be materially aided in his guidance work insofar as advising the individual to take certain work in the regular academic curriculum."[23]

The studies by Ross, Hooks, Newland and Tozer substantially agreed on a number of major points. For instance, Ross and Hooks (1930) (United States) recognized that "adequate guidance both educational and vocational, is the most acute problem of the modern high school and is substantially dependent on the ability to predict high school achievement."[24]

This concept has persisted for years and has grown in importance and complexity recently as a result of the monumental expansion of educational systems in both the United States and Canada. Guidance facilities and personnel were extremely important in the 1930's. They are far more important today as a result of the huge increase in the number of course offerings in the high schools.

Studies Related to Policies Governing Guidance Departments And Counselling Personnel

Only in the last decade have guidance departments assumed the importance they now hold. They are presently an accepted department in any vocational or composite high school. Previous to their inception, guidance was carried out largely as a courtesy service to students by administrators and teachers. Morris (1962) in an Edmonton Public Schools study, indicated that "until the introduction of specialized guidance, counselling of grade nine students on course and vocational choices was largely an incidental service provided by teachers and principals."[25] There were, of course, a few isolated attempts to provide specialized counselling services either through the teaching of particular courses or through the appointment of part-time or full-time guidance personnel.

Educators will probably agree that previous to the past decade, there was very little actual vocational counselling done. The channels open to most high school students were simple and clear cut. Either a student was an academic or he was not. Either he was headed toward

university or he was not. There is now a wide range of offerings of academic, business, and technical courses. This has necessitated an unprecedented expansion in the departments of pupil personnel services. Professional educators have examined problems of how to provide adequate guidance services with extremely informative results. Morris, in his study mentioned above, concluded that "if vocational guidance instruction is given before counselling, there is evidence of considerable change toward realism of choice."[26] In addition Morris found "that group guidance and counselling were better than either procedure alone, in effecting a higher degree of realism of choice of vocation and education."[27] As has been repeatedly voiced by other educators, Morris added that "there is a need for more precise and demanding statistical evaluation."[28]

Another study of significance, respecting the effects of counselling and non-counselling, was made by Matulef, Warman, and Brock (1964) (United States). They studied the effects of brief vocational counselling on temporal orientation. Major findings indicated that "counselling apparently enlarged the counsellee's time perspective."[29] This outcome is congenial with current conceptions of the

counselling process as an opportunity for the counsellee to assess his plans, resources, needs, liabilities and immediate and long term goals. It may be naive to suggest that a grade nine or grade ten student is mature enough to carry out all of the above elements of self assessment. For instance, in a survey carried out by Friche (1939) in the Edmonton Public Schools in relation to choices of grade eleven students respecting their vocational plans: "There were great differences in the mental abilities of students selecting the same occupation. The range was so great that it was very unlikely that all would make satisfactory vocational adjustments."[30] The findings of this investigation emphasizes the necessity for the schools to provide adequate guidance for all students in order that they will have an opportunity to assess their strengths and weaknesses, make a realistic appraisal of themselves and choose an occupational goal in line with their mental abilities. Generally, Friche found that "Edmonton students at the grade eleven level are not realistic and that their level of aspirations is too high."[31]

Continuous vocational counselling may help the student to verbalize previously undefined goals and societal roles. As the counselling process continues, a crystallization

often will take place within the student's mind, in many cases abruptly clarifying previously misty concepts and outlooks.

There is some evidence to suggest that certain categories of students have the capacity to absorb counselling objectives and establish long term vocational goals at the grade eight level. Holden (1961) (United States) for instance, studied the scholastic aptitude and the relative persistence of vocational choices among eighth grade students and continued the study with the same students at the eleventh grade. Holden hypothesized that the aspirations of High I.Q. students are reasonably real and that fairly stable programs of study can be planned at the eighth grade level. This hypothesis was upheld. It was found also that "the tremendous change in the level of occupational choice is not necessarily distributed throughout all scholastic ability levels but was concentrated largely in the low I.Q. groups."[32] While Holden's study is of interest, there is a substantial number of other studies which tend to brand the general body of students in grades eight to twelve as immature, inconsistent in their vocational choice and in many cases completely unrealistic in their

outlook. It is the writer's opinion that this evidence serves to point out the crucial need for a comprehensive, intelligent, and statistically based approach to sound and useful counselling policies.

Other studies serve to point out the need for a reliable, valid, and useful approach to guidance practices in the modern, composite, vocational school. A number of these studies were reviewed.

Super (1961) of Columbia University carried out a study on Consistency and Wisdom of Vocational Preference as Indices of Vocational Maturity in the Ninth Grade.

Super believed that "consistency of vocational preferences show intensity and validity of interest."[33] In his review of Fryer's (1931) (United States) and Carter's (1944) (United States) work, he found that "the expressed preferences of boys and girls in their early and middle teens are unstable."[34] He further found, in Schmidt's and Rothney's (1955) (United States) work, convincing evidence on the instability of expressed vocational preferences from one year of high school to the next and into the first year out of school. "Only 49% of the choices of the tenth grade remained the same in the eleventh grade and

this figure was reduced to 35% in the twelfth grade and to 24% in the year following graduation."[35]

O'Hara and Tiedman (1959) (United States) theorized that "the work history or career patterns of an individual is the fundamental criterion for studies on the vocational development of youth."[36] Implications indicate that a longitudinal observation of a student's work history or choice of career pattern may be an important indication of his suitability to a particular vocation and may have predictable elements.

O'Hara and Tiedman (1959) (United States) carried out an investigation on "the self concepts of boys" as they passed through high school. Results indicated that "interests and work values are modified from grade nine through grade twelve and that an understanding of their ability or aptitudes is poorly grasped by even the most capable students."[37]

Montesano and Geist (1964) (United States) confirmed O'Hara's findings in their study of a group of ninth and twelfth grade boys on their occupational decision making. Indications were that "ninth grade boys rely to a greater

degree than twelfth graders on interests and need satisfaction. An assessment of actual abilities was not seriously considered by either group."[38]

Gribbons (1964) (United States) interestingly enough in his investigation of the Validation of Vocational Planning Scales, found that "eighth graders possess a readiness for developing accurate perceptions of their abilities since they are being forced to make pre-vocational choices."[39] This study partially confirms Holden's (1961) (United States) study on eighth graders.

The relationship of these studies to the writer's present study is not a direct one, but there are many implications. It is contended that basic counselling practices are inadequate in the school being studied and in others in the Edmonton system. It is further contended that the multitude of previous studies and present observations of actual school situations concur to indicate that a state of confusion exists in the minds of the majority of high school students with respect to vocational decision making. Any element contributing to the clarification of the situation which exists will be of benefit to student and counsellor alike. The examination of the elements of

relationship between the grade nine variables and the grade ten criteria will serve to establish or eliminate the possibility of the existence of predictive elements within the grade nine variables and may be a valuable source of information for the counsellor and the student.

Many underlying factors not considered by this study will continue to exist but may be detected by later studies. The existence of such conflicting evidence however was alone sufficient to document the approach for this study.

Studies Structurally Similar to the Writer's Study

A number of studies in related literature was found to be structurally similar to the writer's present investigation. The results and implications of these studies are given here and are suggested to be worthy of consideration.

I. Moysa, W., A Study of the Comparative Value of the Predictive Tests Administered in the University High School, Edmonton. 1946.[40]

All students at the grade ten, eleven and twelve levels were used as the sample for the school years 1946-47 and 1947-48. Moysa's major findings indicated:

> 1. No particular intelligence test has proven outstanding in predicting academic achievement in the high school grades.

2. In grade ten there tends to be more significance between the predictive tests and academic achievement than at any other grade level.

3. In grade eleven, no significance was indicated between any predictive tests and achievement.

4. Intelligence tests and reading achievement tests may be relied upon to predict achievement in the high school with a reasonable degree of accuracy.

5. In this grade (grade nine), more than any other, students require educational guidance to indicate reliably their chances of success in certain high school subjects.

This study underwrites the opinion of the writer as to the importance of having reliable predictive knowledge for as many high school subjects as possible.

II. Case, H. W., The Relationship of Certain Tests to Grades Achieved in an Industrial Class in Aircraft Design. (University of California, Los Angeles) 1952.[41]

A series of tests was given to twenty semi-technical employees of three engineering departments, who had been selected to enter a class in aircraft design.

The correlation coefficients between the test scores and the weighted average of the grades made by the students was from .56 to -.32.

1. It appears that the use of certain tests may be advisable to predict the aptitude of individuals selected to undertake advanced study fundamental to aircraft design.

2. General capacity as measured by the Otis Self Administering Test of Mental Ability and the California Capacity Questionnaire (language score) appears to be related to success in mastering the areas of technical knowledge covered in a class of this nature.

3. The ability to determine spatial relations as measured by the Survey of Space Relations Ability appears to bear a positive relationship to success in advanced study fundamental to aircraft design and drafting.

4. Individuals having high computational interests as measured by the Kuder Preference Record are more likely to be successful in a design class of this nature.

The underlying implications for the writer's study are that aircraft design and drafting may be fundamentally related to certain vocational courses such as drafting and electronics, both of which have a high degree of abstract and spatial relationships.

The tests used on the students in Case's study included:

1. The Otis Self Administering Test of Mental Ability, Higher Examination (R=.55).

2. The California Capacity Questionnaire (R=.42).

3. The Survey of Space Relations Ability (R=.56).

4. The Bennett Test of Mechanical Comprehension (R=.12).

5. The Kuder Preference Record (R=.40 to -.32).

The first three of these tests may be of value for determining the existence of similar elements in students at the grade nine level. In this respect, it is to be noted that in a study completed by Bolton in 1963, a battery of fourteen grade twelve tests were administered to eighth and ninth graders. Except for one test involving motor skills and dexterity, the means were appreciably lower than those for grade twelve students. However only three tests appeared to be too difficult for the younger students (these were not identified by the author) and the battery of tests were used with good results.[42]

III. Bruce, W. J., Some Evidence on the Effects of the Use of a Basic Matrix in Multiple Correlation. (University of Washington), 1954.[43]

This investigation was concerned with the relative efficiencies of a basic matrix and criteria matrices when they were used as predictors of success for first year university. Bruce used two groups of students, 2,243 in the fall quarter of 1947, and 1,914 in the fall quarter of 1950. Predictor variables used were final grades in high school English, Mathematics, Foreign Language, Social Science, Natural Science, electives and the scores from

the ACE test. The criteria used were two years (1947 and 1950) of first year university grade averages in four areas: Anthropology, Chemistry, Geography and Mathematics. For each group multiple coefficients were computed in two ways: by using a basis matrix; by using a set of criteria matrices.

The basic matrix was defined as a single inter-correlation matrix based on the total effect of all the predictor variables. The criteria matrices were defined as individual correlations of each predictor with each criterion. Since a great deal of time and expense was required to produce the criteria matrices, the objective of study was to determine how much less efficient a predictor the basic matrix might be. The maximum difference found to exist between the basic matrix and the criteria matrices was .007. Therefore very little loss in predictive power would have resulted had a basic matrix been used.

Bruce's conclusion was that "it appears for relatively large sub-groups as these in which the predictor variable means and sigmas differ very little from those of the total group and from one year to the next, the basic matrix is relatively stable. Its use in multiple correlation and prediction is worthy of consideration.[44]

The writer's present study will in effect, be a pilot study with one objective similar to Bruce's study. Specifically, an attempt will be made to form a basic matrix for use at the high school level in the school concerned. Any practical use for predictive purposes found in the study may indicate that similar studies should be repeated in the same school.

IV. Zurowsky, J., Predicting Freshman Success in Seven Science and Two Business Administration Courses at the University of Alberta.[45] 1957.

The experimenter in this study attempted to establish the predictive relationship (if any) between the grade nine and grade twelve variables and the variables as indicated in the first year of university.

Major findings were as follows:

1. Grade nine predictors had a low or negligible relationship with the criteria (University) variables.

2. Achievement in Language (grade nine) for success at university proved to be an important consideration.

3. The grade nine departmental examinations in Social Studies B (language), Mathematics, and Science were found to be the most useful in predicting success in the freshman course criteria and in the university average criterion.

4. The median correlation of these subjects (in item #3) were .330, .318 and .296 respectively.

5. The best individual predictors of the grade twelve departmentals were the Science average (r=.632), Mathematics average and the Social Studies average.

6. A slight improvement over individual predictors was obtained through combining the grade nine predictors and using them as teamed combinations. Results here, however, were still not of sufficient significance to warrant setting up regression equations.

Zurowsky concluded that the grade nine and certain grade twelve departmental examinations tended to be promising criteria for predictive purposes for success in certain university courses.

Grade nine predictors had significant but low relationships with the criteria. Certain grade twelve predictors should be valuable for guidance purposes for people intending to enter university. Certain batteries of predictors in grade nine and twelve were better predictors of success in certain university courses.

V. Doppelt, J. E.; Seashore, H. G.; Odgers, J. G.

Validations of the Differential Aptitude Tests for Automotives and Machine Shop Students. (Ohio), 1959.[46]

Over the period 1954 to 1959, seven Ohio vocational schools participated in this study.

In 1954 the D.A.T. was administered to all students beginning two year courses in Automotives and Machine Shop. The D.A.T. included tests of verbal reasoning, numerical ability, abstract reasoning, space relations, mechanical reasoning, clerical speed and accuracy, language useage and sentences.

Grade scores were not used as criteria variables, since no common standards were apparent among the seven schools. Instead, rating data were used. Each instructor rated his own students on four points: (1) understanding of trade information, (2) job know-how, (3) quality of work, (4) quantity of work. Five categories ranging from inadequate to excellent were given for each trait. The ratings were given at mid-term in the first year and again at the end of the second year. For data analysis the five ratings were condensed into three ratings and triserial correlations were computed between these criteria and test predictors.

The results of the study were:

For Auto Mechanics Students

1. Language useage-spelling test yielded the highest correlation with grade eleven and grade twelve ratings on the trait understanding information.

2. The grade twelve ratings on this trait were also related to scores on the D.A.T. numerical ability, abstract reasoning and sentence tests.

3. The prediction of over-all accomplishment of Auto Mechanics students was not satisfactory.

For the Machine Shop Students

1. The relationships between the D.A.T. and ratings were sufficiently high to permit useful predictions of how students will be rated on all traits.

2. The sum of the scores on the D.A.T. mechanical reasoning, space relations and abstract reasoning tests was selected as a predictor of both grade eleven and grade twelve ratings.

Implications respecting the predictors language, space relations, mechanical and abstract reasoning may be important parallel relationships to the writer's study.

VI. Motto, J. J., Interest Scores in Predicting Success in Vocational School Programs (Michigan, U.S.A.) 1959.[47]

Motto used eighty students who were enrolled full time in trade courses at Michigan's Veterans Trade School from 1951 to 1955.

The Kuder Preference Record (form CH) was administered to each student before he entered the trade school.

Two groups of forty students each were randomly selected from the trade school. One group was selected

from those who finished training and were placed in industry. The other group was selected from those who did not finish training.

Conclusions reached by Motto were:

1. None of the Kuder Preference Record Scales significantly differentiated successful from unsuccessful vocational school trainees.

2. Vocational school trainees tend to produce a Kuder profile which is characterized by a flatness and an absence of scores which fall beyond the highest and the lowest quartiles.

The findings of this study confirm the present writer's experience with high school vocational students. Often there appears to be no reason whatever for one student passing and another failing, both of whom appear to be equally suited for the particular area. Further, vocational classes are often characterized by the absence of extremely low ability and extremely high ability students. Perhaps most of the extremely low ability individuals either drop out of high school or are channelled into "Opportunity" classes. The Edmonton Public School System recently implemented a program which meets the requirements of lower ability students and effectively strains them out of the main high school stream after having attended grade nine for one year or more.

Drafting and Electronics classes appear to attract more of the higher calibre students than other areas although there are isolated examples of high ability students in most vocational areas. Perhaps because Drafting is generally a required course for all vocational students and because more stringent admission requirements exist in Electronics, there is a reason for more of the higher ability students in these areas. Sheet Metal and portions of the Pipe-Fitting courses are, however, highly abstract in their content and require high ability in abstract and spatial relations to master the content. It is assumed, since the bulk of the students in these areas are not of average to high ability, that they do not master these portions of the course.

VII. Swanson, E. D.; Berdie, R. F., Predictive Validities in an Institute of Technology (University of Minnesota, Institute of Technology), 1961.[48]

Swanson and Berdie used data from the Technical Institute, compiled from 1941 to 1960 to determine the effectiveness of certain admission tests. The tests included were English, Mathematics, Chemistry, Psychological and Vocational Interest. Groups of freshmen ranged in numbers from 105 to 620 for the period mentioned. Correlations

between first quarter grade point averages and the Institute's Mathematics Admission Test were the highest.

For instance, results indicated that:

1. The Institute of Technology's Mathematics had by far the highest correlations with the first quarter grades of any of the measures studied and had a higher single correlation with the grades than any combination of other measures in a multiple correlation.

2. Correlations of between .64 and .70 for the first quarter grade scores and the I. T. Mathematics course have been consistently obtained.

The investigators concluded, however, that:

> Further studies need to explore such variables as size of high school, father's occupation, parents' education, socio-economic level of student's home, measured interest patterns of students, student's extra-curricular activities and similar non-academic variables to see if further improvements can be made in predicting success at the Institute of Technology.[49]

These latter non-academic elements have been repeatedly confirmed as contributive elements to the success or failure of students at all levels.

VIII. Lewis, J. W., Utilizing the Step-Wise Multiple Regression Procedure in Selecting Predictor Variables by Sex Group[50] (University of Iowa) 1962.

Lewis attempted to determine from a battery of eleven predictor variables, at the grade twelve high school level,

those which yielded the optimum estimate of first quarter grade point average by sex group at Southern Illinois University. The predictor variables used were: rank in high school graduating class, SCAT (School and College Ability Test), Form 1-A, verbal, numerical and total score, co-operative English, form higher level, English grammar, punctuation, spelling, English total, reading vocabulary, reading comprehension, Illinois mathematics, placement, Form AA, total.

The sample consisted of 1,158 men and 840 women who entered the university in the fall quarter of 1960.

The step-wise multiple regression equation was used to compute beta weights for each variable.

Results indicated that:

1. SCAT yielded the largest zero order correlation with the criterion.

2. SCAT total, high school rank and co-operative English grammar accounted for all but 2% of the explained male criterion variance and all but 1% of the explained female criterion variance.

3. The optimum battery of predictor variables yielded statistically more accurate estimates for female subjects than for male subjects.

This study by Lewis is of interest because of its structural and statistical similarity to the writer's study.

IX. Bolton, F. B., Value of a Vocational Aptitude Test Battery for Predicting High School Achievement (East Chicago Public High School) 1963.[51]

This study was initiated as a result of continuing pressure for more data which could be used to advise vocational students at the high school level. Two high schools were selected for the study. The schools included grades seven to twelve and offered five curricula: (1) college preparatory, (2) general, (3) business education, (4) trade and industry, (5) home economics.

Half of the requirements for graduation were identical for all five curricula. About half of the girls were business education majors. About 40% of the students drop out before graduating. At the completion of the study the enrollment of both schools was three thousand seven hundred and forty-five.

A pilot study was commenced in May, 1956 by administering the battery of tests to two hundred and thirty second-semester eighth graders. The tests administered as predictor variables included the Flanagan Aptitude Classification test (comprised of fourteen tests) and four additional tests: the Henmon Nelson (mental ability), the

Terman McNamar (mental ability), the Iowa Every Pupil test (basic Arithmetic), the Iowa Test of Basic Skills (Arithmetic).

This study continued to its conclusion in 1963.

Some pertinent observations were made:

1. Calculations were made for sixty-one different offerings or sequence of offerings.

2. Regression equations were developed for all predictor variables and related criterion variables.

3. Single predictors and batteries of predictors were set out as they occurred as the best predictors of success in single subjects and groups of subjects and patterns of subjects.

Conclusions drawn from results:

1. It was concluded that the final battery of tests (several tests were deleted as a result of their inconsequential predictive value) had value for differential prognosis.

2. Predictors previously thought to have little or no relation to a subject apparently were significant as predictors. (This point was confirmed by Black and Zurowsky in their findings which indicated that grade twelve Social Studies was a good predictor of success in university engineering. The two areas seemingly are unrelated.)

3. After three years the correlation coefficients were tested and did not appear to have lost their predictive power.

4. The final conclusion made by Bolton was that the results of the study indicated that the class of 1956-57 high school freshmen could have benefited from the predictive knowledge obtained from the study.

Studies Specifically Related to Technical Education

Several studies have been completed which are specifically related to Junior and Senior High School Industrial Arts courses and are of interest here because of the relationship of these courses to vocational courses.

I. W. P. Wagner, An Evaluation of Selected Tests as Predictors of Success in Industrial Arts (Edmonton Public Schools, Edmonton, Alberta) 1951.[52]

The purpose of this study was to evaluate certain aptitude tests used as predictors of success in Industrial Arts. The sample used consisted of all students entering high school Industrial Arts at the grade ten level in the Edmonton Public Schools.

Results indicated:

1. A significant correlation at the .01 level between the predictor criteria and the criterion scores.

2. The Space Relations (Minnesota Paper Form Board) and the O'Rourke tests showed the highest significance.

3. The McQuarrie Abstract Reasoning and the Otis test of intelligence followed in order. Coefficients obtained for the above (#2 and 3) were .500, .479, .472, .442, .383 and .257 respectively.

4. The coefficients were too low to predict accurately success in an Industrial Arts course from any individual score.

5. A battery of tests is better than a single predictor.

II. Nemzek, C. L. and De Heus, J. H., The Prediction of Academic and Non-Academic Marks in Junior High School. 1954.[53]

These investigators purport that functions now measured by the intelligence tests available only show a moderate degree of relationships to academic achievement. In addition, the correlation between intelligence results and achievement in special subject matter fields, such as Industrial Arts, Fine Arts, Physical Education and Home Economics is even lower.

The Detroit Mechanical Aptitude test is designed to predict scholastic success in Industrial Arts as well as in academic subjects. The predictive value of the I. Q., the Metropolitan Achievement test and chronological age were evaluated. None of the four predictor variables correlated with achievement in Industrial subjects. Nemzek and De Heus concluded that their study showed a fairly high degree of relationship between I. Q., Mechanical aptitude and achievement test scores. There is a strong indication here that different predictive criteria must be developed for use by students and counsellors in the selection of Industrial Arts courses.

The above studies will serve to permit a sufficient comparison of methods used and results obtained by various educators interested in similar areas. The underlying implications and confirmations as well as the structural approach to their surveys are important as comparative information for the present study.

Observations from the Literature

An overview of the literature reviewed by the writer reveals a number of important points:

1. The majority of the studies reviewed were conducted in the United States.

2. Very few studies directly related to vocational education were available.

3. Most of the studies were statistically oriented. That is, very few were descriptive surveys.

4. It was a practical impossibility to review all of the related literature. Literally thousands of studies have been carried out and many more are being completed.

5. Judging from the number of prediction type studies available, educators have sensed the need for more of this kind of data.

6. A large number of studies have been carried out relating the grade twelve average with success in the first year of university. This particular criterion (the grade twelve average) has consistently been upheld as the best single predictor of first year university success.

7. Of the number of studies directly concerned with predicting success in High School Industrial Arts, all of them indicated that admission tests presently being used were not efficient predictors.

8. All statistical studies concerned with the use of multiple regression analysis agreed that combinations of predictors were consistently more efficient than single predictors.

It will be of interest to point out certain information which has been recognized in the literature concerning predictors, their use and efficiency, implications for guidance personnel and implications to this study.

Predictors

There are many types of predictors. Generally they might be classified as statistical or non-statistical. Certain predictors such as school grade averages, individual scores in school subjects and scores obtained from standardized tests have been in common use by investigators and are generally considered to be statistical in nature. Knowles, Travers, Garrett, Henry and Zurowsky to mention only a few, have used these types of predictor variables.

There are many other kinds of predictors. Some of them are very difficult to use since no standardized procedure has been implemented which can accurately define them and place them in a mathematical context or structure.

Newland, Swanson, Berdie, Sears, Proctor and Viteles suggest many elements for consideration as predictors of success in a broad spectrum of subjects. Included are size of high school, father's and mother's occupation, parents' education, socio-economic status of the home, measured interest patterns of students, student's interest in extra-curricular activities, character and personality ratings, past school records, stability-instability scores, amount of reading performed, and school habits. Many more can be added to the list. Essentially, what is being stated is that the elements involved in a student's total environment all contribute in some way to his success or failure in school.

Having established valid, reliable and useable predictors, the personnel using them must exercise considerable caution. Few predictors approach perfect prediction levels. Most predictors considered as acceptable have coefficients in the .60 to .80 range. Obviously there is still a high proportion of chance involved. The counsellor therefore must use such data only as guide lines tempered with a great amount of flexibility and consideration of a multitude of other factors affecting a given situation.

In most cases, batteries of predictors apparently are far more efficient than single factor predictors. Black and Zurowsky, along with many others, have confirmed this point. The counsellor obviously must attempt to use the total contributing effect of all elements in an individual's case if there is to be an efficient prediction. The use of multiple correlation techniques to combine individual predictors into combinations of more efficient predictors has been underwritten consistently by each of the studies reviewed.

Predictors Presently in Use

The Edmonton system practically exclusively uses past performance and standardized tests as predictors of success in each grade being entered by the student. The difficulty in using multiple regression analysis especially with the lack of computing equipment is readily apparent. Time, facilities, knowledge, finances and personnel are generally lacking. Only a systematic approach involving the creation of a computing science department will gradually produce valid and reliable achievement measurements and will eventually offset the present great gap in this area of vital importance.

Observations Partially Justifying this Study

A high degree of instability of students' vocational choices was evident from the literature for all grade levels and in post high school years. Super, O'Hara and Tiedman confirmed this finding and indicated a need for reliable predictive information related to the vocational aspirations of young people. Holden's and Gribbon's findings, however, indicated that students of high ability tend to be more stable in their vocational choice over a period of time. Evidence from the literature also points out that the majority of students in vocational areas are of neither extremely high nor extremely low ability. Hence the need for information of the type produced by studies similar to the writer's.

The literature repeatedly indicated that those systems which made available guidance personnel and predictive information to vocational students (Morris and Matulef confirm this) had positive beneficial effects on the decision-making of students respecting their vocational choices. The writers pointed out, however, that more studies similar to this investigation were required so that more precise statistical information will be available.

Investigations conducted by many other authors indicated general agreement on certain results. Grade twelve Language, for instance, proved to be a good predictor in studies by Case, Zurowsky, Doppelt and Lewis. These studies were generally concerned with the relationships between grade twelve and first year university. Grade nine Language, as a predictor in the writer's study, was one of the least efficient. Perhaps the contents of the two language courses are oriented to completely different aspects of achievement. The SCAT score (quantitative), Mathematics, Science and Spatial Relations appeared repeatedly as the best single predictors of success at the grade nine level. Since it is virtually impossible to compare closely the course contents in which success is being predicted, conclusions of similarity in results can only be surmised as being possibilities.

A study by Doppelt indicated that ability in Language, numerical ability, abstract reasoning, and space relations were indicative of success in Machine Shop and Automotives classes at the grade eleven level.

A finding by Nemzek and De Heus concurred with the growing number of results indicating the I.Q. factor as a

poor singular predictor of academic achievement. These results simply confirm the more efficient use of multiple predictors as opposed to single predictors.

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CHAPTER IV

STRUCTURE OF THE INVESTIGATION

This study was concerned in its statistical treatment only with grade nine variables as listed and the relationship that exists between these variables and the grade ten vocational subjects as listed.

The significance of the relationship as determined was concerned only with the value that the grade nine variables had for predicting success in the grade ten vocational courses.

The Sample

The sample used for this study was all students who had registered in and completed one or more of the selected grade ten vocational courses during the three school terms at the selected High School from 1963 to 1966 inclusive.

The grade ten vocational subjects used were Automotives 12, Beauty Culture 12, Carpentry 12, Commercial Foods 12, Drafting 12, Electricity 12, Graphic Arts 12, Pipe Trades 12, and Sheet Metal 12.

A total of 443 students were used for the sample. This number constituted individuals who took from one to

as many as four courses. The number of students in each subject area were:

Automotives	221
Beauty Culture	30
Carpentry	85
Commercial Foods	12
Drafting	387
Electricity	113
Graphic Arts	101
Pipe Trades	52
Sheet Metal	86

Only those students on whom complete data were available at the grade nine and grade ten levels were used. Although Commercial Foods and Beauty Culture had relatively low N's, they were included for purposes of interest.

As was noted, the study utilized data over a three-year period in an Edmonton Composite High School. When using data over an extended period of time, several assumptions must be made and qualified by observation and statements.

It is assumed that for the three year period concerning this study: (1) the level of teaching and the standard of marking in the school under consideration remained approximately the same, (2) that no appreciable change in admission policies for vocational courses at the grade ten level was implemented by the school administration, (3) that the standards in grade nine teaching and in the Department of Education's marking policies remained approximately the same. (Both segments of this assumption were confirmed with officials of the school and Department of Education respectively).

TABLE I

PREDICTOR VARIABLE MEANS FOR EACH OF THE THREE YEARS

Year	Reading	Lit.	Lang.	Soc.St.	Math.	Science	V.SCAT	Q.SCAT
1962-63	48.0	48.2	47.8	53.3	48.1	52.3	50.0	52.1
1963-64	45.3	45.3	45.5	48.3	45.4	49.0	45.5	47.8
1964-65	45.5	45.8	45.3	48.7	45.8	53.0	46.1	53.6

The average difference in the means for the years 1963 and 1964 was 3.21% and 1.31% for the years 1964 and 1965. It is assumed that these differences would not affect the results of the study to an extent that would prevent the three years from being combined as one sample in order to obtain sufficient N's.

Data Used

The data used were the final marks in each vocational subject, as submitted by the school administration to the Department of Education for each of the years concerned.

The data used for the correlation of the same group of students consisted of their final scores in the eight grade nine variables as reported to the school administration on the usual form from the Department of Education for each year concerned. All data used for grade nine students was in stanine form and included English (Language), Mathematics, Reading, Science and Social Studies as well as the Verbal and Quantitative scores from the S.C.A.T.

All data were compiled from official school and Department of Education records. They were then transferred to I.B.M. cards and set up to be programmed for Step-Wise Multiple Regression Analysis.

Specifically, the grade nine predictor variables in stanine form were:

1. Reading
2. Literature
3. Language
4. Social Studies
5. Mathematics
6. Science
7. Verbal S.C.A.T.
8. Quantitative S.C.A.T.

Similarly, the grade ten criterion variables as recorded by school officials in final mark form, were:

1. Automotives 12
2. Beauty Culture 12
3. Carpentry 12
4. Commercial Foods 12
5. Drafting 12
6. Electricity 12
7. Graphic Arts 12
8. Pipe Trades 12
9. Sheet Metal 12

Statistical Analysis

For each group of students within each criterion variable, there was an associated set of eight grade nine predictor variables.

There were nine such criteria variables and eight such predictor variables.

For each criterion and its related predictors, computations were carried out for means, variances, standard deviations, and correlation coefficients. In addition, the step-wise regression analysis and the analysis of variance produced "t" values associated with combinations of predictors, F values, variances, probabilities and relative predictor Beta weights.

All relevant data, for purposes of this study, were set out in tables for easy reference and cross checking.

A matrix indicating the relationship between predictor and criteria variables was set up.

An indication of the best predictor for success in each of the criteria variables could be interpreted easily from the matrix.

Intercorrelation tables show the inter-relationships of predictor criteria, indicating the differential effect of combinations of predictors established by the regression analysis. These tables are set out in the Appendix.

CHAPTER V

RESULTS OF THE STATISTICAL ANALYSIS

Intercorrelation Coefficients

The highest and lowest correlations between each predictor and the criteria variables are set out in Table II. All correlations are set out in Table XIV, page 99.

TABLE II

HIGHEST AND LOWEST PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS

Criteria Variables	Predictor Variables and Correlation Coefficients			
	Highest		Lowest	
Automotives	Science	.490	Lit.	.197
Beauty Culture	Qu. SCAT	.424	Lit.	.174
Carpentry	Math.	.370	Ver. SCAT	.074
Commercial Foods	Qu. SCAT	.283	Lang.	-.302
Drafting	Math.	.392	Ver. SCAT	.113
Electricity	Science	.605	Reading	.215
Graphic Arts	Science	.473	Ver. SCAT	.220
Pipe Trades	Social St.	.393	Ver. SCAT	.172
Sheet Metal	Math.	.428	Reading	-.064

Science and Mathematics had three each of the highest correlations with a criterion variable. Verbal SCAT had the lowest correlation with four of the criteria variables.

Literature and Mathematics each had two of the lowest correlations with the criterion variable.

Single Predictors, Batteries, and Interpretations

The most efficient combination of predictors contributing significantly to success in each criterion variable are listed in Tables III to XI.

TABLE III

PREDICTOR BATTERY FOR AUTOMOTIVES 12

Criterion	N	Predictors	% of Variance
Automotives	221	Science	24.05
		Math.	2.57
		Lit. (negative)	1.69
		Verb. SCAT	1.11
			29.43

Interpretation

The most efficient single predictor of success in Automotives was Science, which accounted for 24.05% of the variance.

A combination of Science and Mathematics, accounting for 26.63% of the variance, constituted the best pair of predictors. Literature (contributing negatively) and Verbal SCAT, although accounting for a small percentage of

the variance, were significant at the .01 level of confidence and were therefore included in the predictor battery.

Literature's negative contribution indicated that a portion of the variance was inversely related to this predictor. A low correlation should therefore have existed between Literature and Automotives. This is confirmed in Table XIV, page 99.

TABLE IV

PREDICTOR BATTERY FOR BEAUTY CULTURE 12

Criterion	N	Predictors	% of Variance
Beauty Culture	30	Quant. SCAT	18.03
		Math. (Negative)	13.69
			31.72

Interpretation

Because of the low N of this variable, relatively unreliable relationships may have resulted. Results are given here as a matter of interest. It is not suggested that they will be of any value even as guide patterns for counsellors.

The best single predictor of success in Beauty Culture appeared to be Quantitative SCAT, accounting for 18.03% of the variance.

The best combined pair of predictors was Quantitative SCAT and Mathematics, accounting for 31.72% of the variance. Mathematics contributed negatively and accounted inversely for a substantial portion of the criterion variance. Table XIV, page 99, confirms the inverse relationship between Beauty Culture and Mathematics (R=-.115). As a matter of interest, Verbal SCAT was the next addition to the best combination of three predictors accounting for 38.3% of the criterion variance. A substantial portion of the variance had been accounted for by three of the predictor criteria, a result usual for analysis involving a low N.

TABLE V

PREDICTOR BATTERY FOR CARPENTRY 12

Criterion	N	Predictors	% of Variance
Carpentry	85	Math.	13.69
		Science (negative) . . .	4.37
		Quant. SCAT	1.01
			19.08

Interpretation

The best single predictor for success in Carpentry was Mathematics which accounted for 13.69% of the variance. A combination of Science and Mathematics proved to be the best pair of predictors, accounting for 18.07% of the variance. Mathematics and Science had a correlation coefficient of .502, indicating that to some extent the two variables were measuring the same elements. It would be expected therefore, that Science would have much less effect in the prediction battery.

TABLE VI

PREDICTOR BATTERY FOR COMMERCIAL FOODS 12

Criterion	N	Predictors	% of Variance
Commercial Foods	12	Lang. (negative)	9.12
		Quant. SCAT	14.30
		Social St. (neg.) . . .	24.16
			47.58

Interpretation

As in Beauty Culture, it is again emphasized that because of the low N of this criterion, results obtained

may be unreliable and are given only as a matter of interest.

Language was the best single contributor, although it contributed negatively to account for 9.12% of the variance.

Combining with Language was the Quantitative SCAT (positive) and Social Studies (negative) to account for a total of 47.48% of the variance. The high negative beta weights (Table XIII, page 98) of Social Studies indicates that an inverse relationship between it and the criterion may exist. This is confirmed (R=-.239) as well as the negative correlation of -.302 for Language. Since almost 50% of the variance has been accounted for by the three predictors, the result of using a low N is again indicated.

TABLE VII

PREDICTOR BATTERY FOR DRAFTING 12

Criterion	N	Predictors	% of Variance
Drafting	387	Math.	15.40
		Science	2.68
			18.07

Interpretation

Mathematics was the best single predictor of success in Drafting, accounting for 15.40% of the variance. Science followed but contributed in combination with Mathematics only 2.68% of the variance. Other predictors contributing were not significant at the .05 level of confidence. The best predictor combination therefore (accounting for 18.07%) was Mathematics and Science.

TABLE VIII

PREDICTOR BATTERY FOR ELECTRICITY 12

Criterion	N	Predictors	% of Variance
Electricity	113	Science	36.63
		Quant. SCAT	3.92
		Reading (negative)	1.79
			42.34

Interpretation

The best single predictor of success in Electricity was the Science variable, accounting for 36.63% of the variance. Quantitative SCAT combined with Science to account for an additional 3.92% of the variance. The

best combination of predictors of significance at the .01 level of confidence was Science, Quantitative SCAT and Reading (contributing negatively), accounting for a total of 42.34% of the criterion variance. Mathematics, which is normally required as a pre-requisite course (at least 50 per cent standing) entered the regression analysis only as the eighth best predictor, or the last in a series of eight predictors.

TABLE IX

PREDICTOR BATTERY FOR GRAPHIC ARTS 12

Criterion	N	Predictors	% of Variance
Graphic Arts	101	Science	22.40
		Math.	2.39
		Lit.	1.68
			26.47

Interpretation

The best single predictor of success in Graphic Arts appeared to be Science, accounting for 22.40% of the variance. The best trio of predictors were Science,

Mathematics, and Literature, accounting for 22.40%, 2.39% and 1.68% of the variance respectively, for a total of 26.47%.

TABLE X

PREDICTOR BATTERY FOR PIPE TRADES 12

Criterion	N	Predictors	% of Variance
Pipe Trades	52	Social St.	15.47
		Math.	3.88
		Reading	1.11
			20.45

Interpretation

The best single predictor of success in Pipe Trades was Social Studies accounting for 15.47% of the criterion variance. The best combination of predictors was Social Studies, Mathematics (3.8% of the variance), and Reading (1.11% of the variance), accounting for a total of 20.45%. Social Studies and Mathematics were significant at the .01 and .05 levels of confidence respectively.

TABLE XI

PREDICTOR BATTERY FOR SHEET METAL 12

Criterion	N	Predictors	% of Variance
Sheet Metal	86	Math.	18.38
		Quant. SCAT (negative) . .	4.22
		Language	5.58
			28.18

Interpretation

The best single predictor of success in Sheet Metal was Mathematics, accounting for 18.3% of the variance. Quantitative SCAT (contributing negatively) and Language followed to complete the predictor battery, accounting for 28.18% of the variance.

In summary, the batteries did not tend to be efficient predictors. The average level of explained criterion variance was 29.24%, which is not considered high enough to warrant setting up regression equations from the results of the statistical analysis. The best single predictors, however, except for Beauty Culture and Commercial Foods, may be of use as contributing elements in the assessment of a student's potential in the school concerned.

Observations Respecting Beta Weights

It was noted that some beta weights were higher than others in the matrix but that these weights did not necessarily fall in a progression according to their contribution as predictors. It was observed for instance, that Social Studies has a beta weight of -6.33, with the Commercial Foods criterion. Social Studies however entered the regression analysis only as the third best predictor in a team of three. Language, having a beta weight of -1.78, entered the regression equation as the best single predictor. Perhaps, because of the low N value (12), this comparison does not warrant further analysis here.

The Electricity criterion provided another example of beta weights which did not follow in a descending order. Social Studies for instance, which entered the regression analysis as the fourth best predictor in a team of four, had a beta weight of 3.07. Quantitative SCAT and Reading however, entered the analysis as second and third contributors and had lower beta weights: 2.47 and -1.47 respectively.

These irregularly descending beta weights were related to the proportions of variance accounted for by each predictor criterion and the extent to which pairs of, or combinations of predictors were measuring the same elements within the variance.

Pertinent Points on Prediction Criteria Data

As might be expected from observations of the correlation coefficients, Mathematics contributed significantly for success in Carpentry, Drafting and Sheet Metal. Science was the best predictor for success in Automotives, Electricity and Graphic Arts. Language, Social Studies and Quantitative SCAT were the best single predictors of success in Commercial Foods, Pipe Trades and Beauty Culture, respectively. Reading, Literature and Verbal SCAT did not contribute significantly for success in any of the criteria.

Reading, interestingly, was inversely related with Sheet Metal (beta wt.=-1.21, R=-.064).

In addition, Reading contributed the least to success in Automotives, and had negative beta weights for Carpentry, Drafting, Electricity and Sheet Metal. Reading also had generally low correlations with all the criteria, its highest correlation being with Beauty Culture (R=.303). Reading is not specifically taught or tested at the high school level and is not included in the course content of the criteria. This may account for its poor contribution to an explanation of the criteria variances.

Literature also was a low contributor to success in all of the criteria. It was the lowest contributor in Drafting, Pipe Trades and Sheet Metal and had negative beta weights for Automotives, Beauty Culture, Electricity, Pipe Trades and Sheet Metal.

Social Studies was the lowest contributor to Beauty Culture and Carpentry while Mathematics was the lowest contributor to Commercial Foods and Electricity. The Mathematics contribution was surprising since the subject has always been regarded, along with Science, as being a substantial contributor to success in Electricity.

Levels of Significance

All single and multiple predictors were significant at the .01 and .05 levels of confidence except those associated with Commercial Foods (N=12). The results obtained from Commercial Foods were significant at the .40 and .20 levels of confidence for the two best predictors, respectively.

The best predictor for success in Beauty Culture was significant at the .05 level of confidence. Following were Mathematics, Verbal SCAT and Literature having .01, .05, and .05 levels of confidence respectively.

The second best predictor for success in Graphic Arts and Pipe Trades was the same subject, Mathematics, which was significant at the .05 level of confidence in both cases.

All probabilities were of .001 magnitudes excepting those for Pipe Trades, Beauty Culture and Commercial Foods. For Pipe Trades the predictor criteria, Social Studies, Mathematics and Reading had probabilities of 0.004, 0.005, and 0.011 respectively.

For Beauty Culture, the predictor criteria, Quantitative SCAT, Mathematics, and Verbal SCAT had the probabilities of 0.018, 0.006, and 0.005 respectively.

For Commercial Foods, the predictor criteria, Language, Verbal SCAT, and Social Studies, had probabilities of 0.341, 0.30, and 0.14 respectively.

Levels of significance are given in Table XII, page 81.

Underlined batteries tend to be the best group of predictors for their related criterion. Although there were other contributors in addition to those contained in the batteries, none of the contributions were significant at the .01 or .05 level of confidence.

TABLE XII

LEVELS OF SIGNIFICANCE

Criterion	N	Predictor	Level of Sig.
Automotives	221	Science	.01
		Math.	.01
		Lit.	.01
		Verb. SCAT	.01
Beauty Culture	30	Quant. SCAT	.05
		Math.	.01
		Verb. SCAT	.05
		Lit.	.05
Carpentry	85	Math.	.01
		Science	.01
Commercial Foods	12	Lang.	.40
		Quant. SCAT	.20
		S. S.	.01
Drafting	387	Math.	.01
		Science	.01
		Reading	.01
		Lang.	.01
Electricity	113	Science	.01
		Quant. SCAT	.01
		Reading	.01
		S. S.	.01
Graphic Arts	101	Science	.01
		Math.	.01
		Lit.	.05
Pipe Trades	52	S. S.	.01
		Math.	.05
Sheet Metal	86	Math.	.01
		Quant. SCAT	.01
		Lang.	.01

Conclusions Respecting the Statistical Analysis

It was observed that Science and Mathematics had the highest correlations with more of the criteria than any of the other predictors. Science and Electricity produced the highest correlation (R=.605) of any pair of variables.

Science and Mathematics, as might be expected, were also very good predictors of success, appearing as the best or second best predictor for eight of the nine criteria. Commercial Foods was the only criterion not having Science or Mathematics included at some level in its prediction battery. The low N (12) of Commercial Foods however, does not permit any positive conclusions respecting the presence or absence of any particular variable in its prediction battery.

Literature and Verbal SCAT were consistently low or non-significant predictors. Social Studies was also a consistently low or non-significant predictor except in the case of Pipe Trades where it was the best single predictor.

Reading, often thought of as the core subject providing the basis for learning at all levels, was one of the poorest contributors. Drafting and Electricity, only,

included this subject as their third best contributor each in a battery of four.

The null hypothesis was rejected at .01 and .05 levels of confidence in all cases except Commercial Foods (N=12), where it could not be rejected for Language and Quant. SCAT. However, as the third best predictor in a combination of three, Social Studies was significant at the .01 level. The null hypothesis was rejected for this particular combination of predictors, but because of the low N, results cannot be held as anything more than a remote tendency to produce that which was indicated by the analysis.

CHAPTER VI

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

This study sought to establish the relationship between achievement in certain grade nine predictor variables at an Edmonton high school and certain grade ten achievement variables within the vocational course offerings at the same school.

The grade nine scores used as predictor variables included Reading, Literature, Language, Social Studies, Mathematics, Science, Verbal SCAT and Quantitative SCAT.

The grade ten scores used as criteria variables included Automotives, Beauty Culture, Carpentry, Commercial Foods, Drafting, Electricity, Graphic Arts, Pipe Trades and Sheet Metal.

Intercorrelations of all predictor variables were carried out through internal combinations and with each criterion variable.

The technique of multiple correlation was carried out through the use of the Step-wise Multiple Regression Analysis Program made available through the Department of Computing Science and the Department of Educational Research

at the University of Alberta. This computer program produces in weighted progressions (Beta weights) those predictor criteria which, for the data used, were the most efficient predictors of success in each of the criterion variables. In addition to producing the most efficient single predictors of success, the program automatically sets out the best combinations of predictors for success in each of the criterion variables.

Some improvements were made over the use of individual predictors by the use of batteries of predictors. However, where levels of significance were maintained at .01 and .05, few gains were apparent, these being in the order of 2% to 5% of the variance.

Generally, while some predictor subjects appeared to have a reasonable relationship to the criteria, the correlations were fairly low and the predictive power of individual subjects and combinations of subjects was not outstanding. Apparently, with the exception of Commercial Foods and Beauty Culture, the best individual predictors in all cases, or at maximum the best combination of two predictors, produce approximately optimum efficiency in the prediction of success in the criteria. Commercial

Foods and Beauty Culture do not have a sufficient N to warrant serious consideration of the analysis affecting them.

Final Observations and Recommendations

1. The general results of this investigation warrant consideration as a pilot study. As a consequence, other investigators may become interested in conducting further, similar studies in the Edmonton system. For instance, the Department of Pupil Personnel Services in the Edmonton Public schools has only recently been organized. It is possible that a testing program could be implemented at an early date in the school careers of potential vocational students. Perhaps at the grade five level a series of tests similar to the Flannagan Aptitude Classification battery could be administered. The relevance of these test results to success in technical courses in the Junior High School could be determined as possible strong predictive evidence. The battery could be re-administered on leaving Junior High School (grade nine), and could possibly augment the Departmental examinations' predictive power to a great extent. The relationship of certain of the

tests containing spatial relations, abstract reasoning, quantitative and mathematical elements may possibly help considerably in predicting the potentialities of individuals both for success in vocational courses and university engineering courses. Since there has been a strong undercurrent at high school and university levels to re-vamp the university admission regulations, the suggestions mentioned in this text warrant consideration.

It is further suggested that in addition to the pool of achievement data that would result from an early sequential testing program, a Department of Computing Science would be a valuable addition to the public school's central administration. In-service training of Administration and Guidance Personnel could then be carried out by expert personnel employed specifically for this purpose. Knowledge of practical statistical procedures could be imparted. Many studies could be undertaken by the proposed Computing Science Department or studies could be supervised while being carried out within the high schools.

The availability of computing equipment has become less of a problem in the recent past. Further, if computing equipment could not be purchased by the school board, liaison

channels for data processing are open at many levels within the City of Edmonton.

It is suggested that regular investigations respecting achievement and predictive statistics be a part of every major high school. These might take the form of a statistical approach similar to this study or an attempt could be made to assess the multitude of non-statistical elements which apparently affect the students' progress. A substantial number of these elements from the literature are given on pages 50 and 51 of this study.

As well as carrying out local high school investigations there is merit in a system-wide annual statistical survey which would include data from all schools in the system. This data could be compiled from central administration records. High school students and facilities presently available in several of the Edmonton schools could be co-ordinated and used to punch the information on to I.B.M. cards. A wealth of predictive information could result over a period of years. Once certain predictors and batteries of predictors have been established as reliable, valid and useable, other areas could be explored. The established predictors could be re-validated every

three years and modified as required. In recent studies by Black (University of Alberta) and Bolton (Chicago) prediction batteries were found to be valid without modification, even after six years of use.

In addition to annual surveys, longitudinal studies could be undertaken. For instance, a study carried out by L. L. Campbell of the Edmonton system compared the achievements of paired sets of students over a period of six years commencing in grade four. Studies of this sort may not involve large numbers of students but very often yield valuable information as a result of their intensive appraisal of the same students over long periods of time.

These types of studies as well as others should not be concerned only with potential vocational students. All academic and non-academic areas should be examined with the objective of acquiring valid and useable predictive data.

2. The usefulness of certain individual grade nine achievement scores as predictors of success in certain grade ten vocational courses was apparent. Guidance personnel in the school concerned would undoubtedly be interested in the patterns developed by the statistical analysis in this investigation.

3. Findings such as the inverse relationships between certain predictor variables and criteria variables require serious consideration and further study. Inverse relationships are not easily grasped by students or school personnel. For instance, the teacher of a Sheet Metal class would not purposely seek out students who were low in the Quantitative SCAT scores. What is required perhaps is to eliminate those tests having inverse or low relationships with the subject concerned and to substitute other more efficient tests. The perfect set of predictor tests would consistently produce nearly perfect prediction. More studies are required which will identify other elements having predictive validity for particular courses. This is, of course, an expensive and time-consuming undertaking for any educational system and this, in all probability, is the reason why certain sets of tests, once established, are not often changed or modified.

4. The fact that certain predictors previously used as pre-requisites for entrance to particular high school vocational courses were displaced by this investigation, warrants serious reconsideration of admission policies by the personnel of the school concerned.

5. Strong relationships between predictor variables and criteria variables should be re-investigated and re-confirmed by further studies. This could be done in the same school as well as in schools offering the same subjects.

6. Certain predictors acted as suppressors in the regression analysis. Assessment and clarification of the relationship of these subjects with their related criteria is needed to confirm or reject their validity as predictor tests. It may be that the measurement of that portion of the variance, even though negatively contributed, is just as important as the positive contributions.

7. Other non-statistical or non-mathematical predictor criteria should be considered in future studies as important contributors to predicting success in high school vocational subjects. Elements such as home status, occupation of parents, stability of the student, personality ratings and many others are suggested by investigators reviewed in the literature as being important contributors to the success or failure of a student. These elements may be recognized as contributors but their effective use in a matrix is nearly impossible. Only observations by the teacher, counsellor and student might bring light to

bear on a number of them so that through experience one might infer some predictive knowledge respecting a student's potentialities. Eventually many of the non-statistical environmental elements affecting a student's progress may be scaled as to their weight as predictors. At present however, and for many years to come, it is unlikely that any element of a non-statistical nature will be used as positive contributors influencing admission policies in high schools or university.

8. It is the writer's specific recommendation that investigations of this type be carried out on an annual basis in each of the Edmonton vocational high schools. This kind of endeavor will eventually produce valid predictive knowledge for all vocational courses which could be made available to all school personnel for the improvement of educational guidance.

Limitations on the Use of the Results

The results of this study, while interesting to the writer and of possible interest to readers, are not conclusive in any way. They are the results of comparisons of sets of data from a particular Edmonton High School. No

inference at any level, nor transfer of conclusions, can be made for use in any school other than the school from which the data was obtained.

For the school concerned with this study, conclusions and indications from the statistical analysis may be more interesting and of more value. However, administrators and counselling personnel are cautioned about the use of any results beyond consideration of them as general indications about a specific set of circumstances in the school, occurring during the time indicated.

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A P P E N D I X

TABLES XIII TO XXXII

TABLE XIII

BETA WEIGHTS AND SAMPLE SIZES FOR THE EIGHT GRADE IX PREDICTORS OF SUCCESS IN EACH OF THE NINE GRADE X CRITERIA VARIABLES

Criteria	N	Predictor Variables							
		Read.	Lit.	Lang.	S.S.	Math.	Science	Verb.	Quant.
Automotives 12	221	-0.24	-1.33	-0.56	0.54	1.53	4.05	1.07	0.23
Beauty Culture 12	30	1.40	-2.27	-1.95	0.46	-3.60	1.63	2.28	2.90
Carpentry 12	85	-0.83	0.62	0.41	0.17	2.87	1.78	-0.45	-0.82
Commercial Foods 12	12	1.93	1.51	-1.78	-6.33	0.46	-3.72	1.30	2.77
Drafting 12	387	-0.89	0.20	0.94	0.56	3.41	1.77	-0.72	-0.53
Electricity 12	113	-1.47	-1.19	0.53	3.07	0.29	7.09	1.05	2.37
Graphic Arts 12	101	0.22	1.36	0.77	1.23	1.89	4.74	-0.91	0.09
Pipe Trades 12	52	1.20	-0.13	0.48	3.60	2.09	-1.50	-0.81	-0.14
Sheet Metal 12	86	-1.21	-0.12	2.23	0.89	3.88	0.52	-0.54	-1.79

Notes:
1. Double underlined Beta weights were the most efficient single predictors of success in the related criterion.
2. Single underlined Beta weights were the least efficient predictors of success in the related criterion.

TABLE XIV

CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES WITH THE NINE CRITERIA VARIABLES

Predictor Variable	Criterion Variables								
	Auto.	Beau. C.	Carp.	Comm. Fds.	Dftg.	Elect.	G.Arts	Pipe Tr.	Sheet Mt.
Reading	.240	.303	.101	-.028	.121	.215	.283	.296	-.064
Literature	.197	-.174	.216	.064	.221	.287	.325	.250	.069
Language	.206	-.090	.194	-.302	.282	.386	.326	.173	.209
Social Studies	.329	-.081	.152	-.239	.274	.470	.362	.393	.172
Mathematics	.404	-.115	.370	.078	.392	.489	.360	.324	.428
Science	.490	.048	.336	-.226	.365	.605	.473	.156	.246
Verb. SCAT	.284	.379	.074	-.245	.113	.329	.220	.172	-.046
Quant. SCAT	.327	.424	.122	.283	.239	.462	.274	.222	.026
N	221	30	85	12	387	113	101	52	86

TABLE XV

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF AUTOMOTIVES 12

Variable N=221	Means	Variances	S.D.
Predictor Variables			
Reading	4.43	2.52	1.58
Literature	4.47	2.17	1.47
Language	4.31	2.32	1.52
Social Studies	4.90	2.62	1.62
Mathematics	4.64	2.34	1.53
Science	5.00	2.18	1.47
Verbal SCAT	4.77	2.57	1.60
Quant. SCAT	4.85	2.87	1.68
Criterion Variable			
Automotives	54.79	148.93	12.20

TABLE XVI

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF BEAUTY CULTURE 12

Variable N=30	Means	Variances	S.D.
Predictor Variables			
Reading	4.70	2.28	1.51
Literature	4.03	1.27	1.12
Language	4.56	1.15	1.07
Social Studies	3.73	1.92	1.38
Mathematics	3.20	1.68	1.29
Science	3.53	1.22	1.10
Verbal SCAT	4.36	1.89	1.37
Quant. SCAT	4.23	2.59	1.61
Criterion Variable			
Beauty Culture	58.00	121.72	11.03

TABLE XVII

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF CARPENTRY 12

Variable N=85	Means	Variances	S.D.
Predictor Variables			
Reading	3.98	2.84	1.68
Literature	4.10	2.38	1.54
Language	3.89	2.00	1.41
Social Studies	4.57	1.79	1.33
Mathematics	4.36	1.63	1.28
Science	4.62	1.80	1.34
Verbal SCAT	4.23	3.01	1.73
Quant. SCAT	4.49	1.99	1.41
Criterion Variable			
Carpentry	58.35	99.04	9.95

TABLE XVIII

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF COMMERCIAL FOODS 12

Variable N=12	Means	Variances	S.D.
Predictor Variables			
Reading	3.91	1.71	1.31
Literature	3.50	1.90	1.38
Language	3.66	2.96	1.72
Social Studies	4.08	.81	.90
Mathematics	3.75	2.02	1.42
Science	4.50	1.90	1.38
Verbal SCAT	4.33	4.24	2.05
Quant. SCAT	4.58	2.08	1.44
Criterion Variable			
Commercial Foods	64.1	103.78	10.18

TABLE XIX

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF DRAFTING 12

Variable N=387	Means	Variances	S.D.
Predictor Variables			
Reading	4.67	2.90	1.70
Literature	4.73	2.50	1.58
Language	4.48	2.62	1.61
Social Studies	5.17	2.40	1.54
Mathematics	4.87	2.22	1.49
Science	5.31	2.23	1.49
Verbal SCAT	4.98	2.88	1.69
Quant. SCAT	5.03	2.78	1.66
Criterion Variable			
Drafting	57.01	168.72	12.98

TABLE XX

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF ELECTRICITY 12

Variable N=113	Means	Variances	S.D.
Predictor Variables			
Reading	5.03	3.33	1.82
Literature	5.12	2.16	1.47
Language	4.68	2.70	1.64
Social Studies	5.59	1.77	1.33
Mathematics	5.26	1.92	1.38
Science	5.90	2.12	1.45
Verbal SCAT	5.30	2.56	1.60
Quant. SCAT	5.47	2.62	1.62
Criterion Variable			
Electricity	52.96	291.80	17.02

TABLE XXI

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF GRAPHIC ARTS 12

Variable N=101	Means	Variances	S.D.
Predictor Variables			
Reading	4.37	2.81	1.67
Literature	4.37	2.19	1.48
Language	4.15	2.29	1.51
Social Studies	4.71	1.78	1.33
Mathematics	4.45	1.61	1.26
Science	4.89	1.85	1.36
Verbal SCAT	4.81	2.75	1.65
Quant. SCAT	4.52	2.57	1.60
Criterion Variable			
Graphic Arts	50.54	186.45	13.65

TABLE XXII

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF PIPE TRADES 12

Variable N=52	Means	Variances	S.D.
Predictor Variables			
Reading	4.25	1.95	1.39
Literature	4.28	2.44	1.56
Language	3.94	1.34	1.16
Social Studies	4.36	1.92	1.38
Mathematics	4.07	1.64	1.28
Science	4.69	1.55	1.24
Verbal SCAT	4.40	2.99	1.72
Quant. SCAT	4.19	2.19	1.48
Criterion Variable			
Pipe Trades	55.09	161.26	12.69

TABLE XXIII

MEANS, VARIANCES, AND STANDARD DEVIATIONS
OF THE EIGHT GRADE IX PREDICTOR VARIABLES
AND OF SHEET METAL 12

Variable N=86	Means	Variances	S.D.
Predictor Variables			
Reading	3.86	2.56	1.60
Literature	4.05	2.07	1.44
Language	3.80	1.68	1.29
Social Studies	4.24	2.18	1.47
Mathematics	3.94	1.67	1.29
Science	4.65	1.73	1.31
Verbal SCAT	4.44	3.12	1.76
Quant. SCAT	4.23	2.34	1.53
Criterion Variable			
Sheet Metal	5.59	138.12	11.75

TABLE XXIV

INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION AUTOMOTIVES 12
(CRITERION N=221)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Ver.	Quant.	Criterion Auto.
Reading	.656	.472	.529	.355	.531	.701	.452	.240
Literature		.572	.656	.417	.577	.642	.418	.197
Language			.471	.514	.462	.480	.477	.206
Social Studies				.528	.586	.580	.471	.329
Mathematics			.552	.325	.681			.404
Science				.513	.486			.490
Verbal SCAT					.379			.284
Quant. SCAT								.327

TABLE XXV

INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION BEAUTY CULTURE 12
(CRITERION N= 30)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Beauty Culture
Reading	.288	.108	.239	.418	.202	.634	.609	.303
Literature		.154	.600	.230	.510	.302	.090	-.174
Language			.058	-.307	.201	.111	-.218	-.090
Social Studies		.471	.635	.377	.121		-.081	
Mathematics			.403	.285	.488		-.115	
Science				.365	.198		.048	
Verbal SCAT					.426		.379	
Quant. SCAT							.424	

TABLE XXVI
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION CARPENTRY 12
(CRITERION N=85)

Predictor Variable	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Carp.
Reading	.736	.403	.535	.150	.449	.720	.432	.101
Literature		.523	.592	.233	.449	.648	.363	.216
Language			.302	.231	.335	.422	.247	.194
Social Studies				.139	.472	.590	.338	.152
Mathematics				.502	.084	.465	.370	
Science					.405	.387	.366	
Verbal SCAT						.311	.074	
Quant. SCAT							.122	

TABLE XXVII
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION COMMERCIAL FOODS 12
(CRITERION N=12)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Commercial Foods
Reading	.576	.469	.160	.329	.426	.583	.364	-.028
Literature		.458	.401	.439	.526	.543	.478	-.064
Language			-.039	.148	.305	.443	.268	-.302
Social Studies				.443	.475	.669	.448	-.239
Mathematics				.485	.310	.653	.078	
Science					.798	.660	-.226	
Verbal SCAT						.601	-.245	
Quant. SCAT							.283	

TABLE XXVIII

INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION DRAFTING 12
(CRITERION N=387)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Dftg.
Reading	.654	.502	.558	.343	.545	.743	.413	.121
Literature		.584	.645	.420	.570	.630	.376	.221
Language			.524	.503	.493	.504	.446	.282
Social Studies				.526	.621	.604	.456	.274
Mathematics				.598	.673	.673	.502	.392
Science					.531	.502	.353	.365
Verbal SCAT						.353	.239	.113
Quant. SCAT								.239

TABLE XXIX
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION ELECTRICITY 12
(CRITERION N=113)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Elect.
Reading	.569	.524	.515	.305	.464	.770	.437	.215
Literature		.540	.572	.416	.522	.574	.394	.287
Language			.579	.581	.482	.507	.510	.386
Social Studies				.439	.590	.579	.330	.470
Mathematics				.564	.344	.716	.489	
Science					.513	.477	.605	
Verbal SCAT						.415	.329	
Quant. SCAT							.462	

TABLE XXX
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION GRAPHIC ARTS 12
(CRITERION N=101)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Ver.	Quant.	Criterion Gr.Arts
Reading	.633	.448	.494	.144	.568	.740	.193	.283
Literature		.534	.539	.152	.475	.618	.075	.325
Language			.398	.295	.434	.469	.327	.326
Social Studies				.290	.575	.588	.243	.362
Mathematics				.474	.079	.593	.360	
Science					.516	.447	.473	
Verbal SCAT						.176	.220	
Quant. SCAT							.274	

TABLE XXXI
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION PIPE TRADES 12
(CRITERION N=52)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Pipe Tr.
Reading	.585	.153	.599	.109	.405	.638	.316	.296
Literature		.376	.610	.253	.499	.550	.280	.250
Language			.159	.385	.245	.060	.234	.173
Social Studies				.359	.520	.583	.403	.393
Mathematics				.359	.083	.405	.324	
Science					.395	.170	.156	
Verbal SCAT						.351	.172	
Quant. SCAT							.222	

TABLE XXXII
INTER-CORRELATIONS OF THE EIGHT PREDICTOR VARIABLES
AND THE CRITERION SHEET METAL 12
(CRITERION N=86)

Predictor Variables	Lit.	Lang.	S. S.	Math.	Science	Verb.	Quant.	Criterion Sheet M.
Reading	.711	.393	.486	-.009	.322	.674	.286	-.064
Literature		.508	.600	.115	.487	.641	.372	.069
Language			.233	.097	.357	.371	.295	.209
Social Studies				.216	.406	.507	.327	.172
Mathematics				.373	-.050	.481		.428
Science					.385	.326		.246
Verbal SCAT						.231		-.046
Quant. SCAT								.026